

# VIBRATING PILL PACKAGING DEVICE AND ASSOCIATED METHOD

## BACKGROUND OF THE INVENTION

### Field of the Invention

The present invention relates to pill packaging apparatuses and methods and, more particularly, to a vibrating pill packaging device and associated method for packaging pills, tablets, capsules, and the like.

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### Description of Related Art

Pharmaceutical products such as pills, tablets, capsules, and the like are often packaged in disposable packaging for distribution to the consumer. Such disposable packaging includes thermoformed and cold formed blister packages as well as pouches, sachets, or disposable bottles.

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Conventional blister packages typically include a generally planar web portion having a plurality of receptacles formed therein. A thermoforming process, for example, can be used to form the receptacles in a thermoplastic web. Each receptacle in the web may receive one or more pills and the receptacles may be arranged in a grid pattern having multiple rows and columns. After pills have been placed in all of the receptacles, an aluminum or plastic foil layer is typically adhered to the planar web portion to seal the pills within the receptacles.

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An important aspect of forming these packages relates to the placement of the pills in the receptacles prior to the foil layer being applied. This procedure is preferably performed by an automated machine capable of precisely and accurately placing the pills into the receptacles at a high speed. An exemplary form of such an apparatus has been commercially available under the name, "Aylward Feed System" from Aylward® Enterprises, Inc. of New Bern, N.C., also the assignee of the present invention. The

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Aylward Feed System includes a feeder cassette and drop chute assembly having a plurality of chutes for guiding pills into the appropriate receptacles. An orienting tray is positioned above the feeder cassette for passing pills into the feeder cassette which, in turn, passes the pills into the drop chutes.

5           The orienting tray, the feeder cassette, and the drop chute assembly are mounted on a frame that extends over a conveyor having a series of empty pill blister packages placed thereon. The frame is generally movable in registration with the pill packages moving thereunder. The frame is fixed in the horizontal direction of the conveyor if the conveyor is an intermittent type. If the conveyor is a continuous type, the frame is moved  
10       on an undercarriage driven at the same speed as the conveyor. Therefore, with a continuous conveyor, the frame “gallops” back to register and moves with the next blister package after the preceding package has been filled.

          Accordingly, as an empty pill package is moved under the drop chute, the drop chute is lowered and an escapement mechanism is activated in the feeder cassette to  
15       release a single pill that falls through the drop chute and into the corresponding receptacle in the package. More particularly, for example with blister packages, the drop chute is lowered and a pill is released to fall through the drop chute until it engages the bottom of the blister. The frame is then raised which, in turn, raises the drop chute and deposits the pill in the blister. This operation defines a gravity feed pill packaging system.

20           The drop chute assembly may include a plurality of individual chutes arranged in a block so as to define a grid. Each of the chutes extends in a generally vertical direction, but may include a portion at the lower end thereof which is angled so that a pill exiting the drop chute does so at an acute angle relative to the blister package.

          In operation, where a pill is being packaged in a loose-fitting receptacle, this type  
25       of system will often place a pill into the blister receptacle by sliding a pill down the drop chute, wherein the lower end thereof is angled so that a pill exiting the drop chute is placed in the blister package at an acute angle relative thereto. Since the pill is deposited into the receptacle at an angle, it will sometimes “slide” into the receptacle until the leading edge of the pill engages a side wall thereof. The drop chute is then moved away  
30       from the blister receptacle to allow the trailing edge of the pill to clear the drop chute and drop into the receptacle under the force of gravity. Thus, the pill is introduced to the

receptacle, essentially diagonally, at an angle corresponding to the angle of the lower end of the drop chute. An apparatus and method of this type for packaging pills is disclosed in U.S. Patent No. 5,737,902 to Aylward, which is incorporated herein in its entirety by reference.

5           Although these types of feeders have achieved widespread commercial acceptance, problems may arise if the pills are being deposited into a package having receptacles that are closely toleranced or “tight fitting” with respect to the dimensions of the pills. Tight fitting receptacles are desirable in some instances, such as in blister packaging, wherein the tight tolerances minimize rattling of the pills within the  
10       receptacles. However, where a pill is to be inserted into a tightly toleranced receptacle using these types of systems, the pill may not be capable of simply being slid into the receptacle in a diagonal orientation.

          For example, for a caplet generally having the shape of a transversely flattened capsule, the dimensions of the receiving receptacle in the blister package may be only  
15       slightly greater than the dimensions of the caplet. That is, the overall length and width of the receptacle may only be slightly greater than the overall length and width of the caplet, respectively. Accordingly, when the caplet is slid into the receptacle at an angle with the leading edge of the caplet dropping into the receptacle and engaging a side wall thereof before the trailing edge is released, the caplet may become oriented with its diagonal  
20       dimension approximately parallel or angled slightly upward relative to the planar web portion of the blister package. In this situation, the maximum dimension of a longitudinal cross-section of the caplet, here the diagonal dimension, may be slightly greater than the length of the accommodating receptacle and thus the trailing edge of the caplet will lie against a portion of the side wall of the receptacle, above the bottom wall thereof. The  
25       force of gravity may not be sufficient to cause the pill to drop fully into the receptacle, which leaves part of the trailing edge of the caplet extending above the planar web portion of the blister packet. This can also occur if the blister package material is wrinkled or otherwise distorted in the bottom or sides of the receptacle. In some instances, a caplet or pill may even “stand up” on its leading edge within a receptacle. As  
30       can be appreciated, these occurrences may have an adverse effect on the subsequent application of the foil layer if the trailing edge of the caplet or pill extends above the

plane of the blister package.

Thus, there exists a need for an improved packaging apparatus and method for placing pills and the like into pill receptacles such as blister packages in a preferred orientation, more particularly in the receptacle and below the planar web portion of the blister package, before application of a sealing foil layer. Such an apparatus and method should be able to quickly and accurately insert the pills, even the pills that are “standing up,” into the receptacles to provide high packaging speed and quality. Such an apparatus and method should also be capable of efficiently and reliably inserting pills into receptacles dimensioned in close tolerance to the pills.

#### BRIEF SUMMARY OF THE INVENTION

The above and other needs are met by the present invention which, in one embodiment provides a packaging device for a pill packaging apparatus, wherein the packaging device cooperates with a plurality of pill receptacles, defined by a web and being conveyed by a conveyor under the packaging device in a packaging direction, to manipulate pills deposited in the receptacles into a laid-down position with respect to the receptacles. Such a packaging device comprises a first wiper device, extending across the web and non-perpendicularly to the packaging direction, configured to engage pills protruding from the receptacles. A second wiper device, downstream of the first wiper device and extending across the web substantially perpendicularly to the packaging direction, is configured to engage any pills still protruding from the receptacles following engagement with the first wiper device. The first and second wiper devices are configured to oscillate substantially transversely to the packaging direction so as to vibrate laterally with respect to the web. The lateral vibration of the first and second wiper devices, as the wiper devices engage any protruding pills, thereby causes the protruding pills to be manipulated into the laid-down position in the corresponding receptacles.

Another advantageous aspect of the present invention comprises a packaging device for a pill packaging apparatus, wherein the packaging device cooperates with a plurality of pill receptacles, defined by a web and being conveyed by a conveyor under the packaging device in a packaging direction, to manipulate pills deposited in the

receptacles into a laid-down position with respect to the receptacles. Such a packaging device includes a first wiper device, extending across the web and non-perpendicularly to the packaging direction, configured to engage pills protruding from the receptacles. A second wiper device, disposed downstream of the first wiper device and extending across the web substantially perpendicularly to the packaging direction, is configured to engage any pills still protruding from the receptacles following engagement with the first wiper device. A plate extends across the web and supports the first and second wiper devices, wherein the plate is configured to oscillate substantially transversely to the packaging direction so as to cause the first and second wiper devices to vibrate laterally with respect to the web. The lateral vibration of the first and second wiper devices, as the wiper devices engage any protruding pills, thereby causes the protruding pills to be manipulated into the laid-down position in the corresponding receptacles.

Still another advantageous aspect of the present invention comprises a pill packaging apparatus for packaging pills in a plurality of pill receptacles defined by a web. Such a pill packaging apparatus includes a conveyor for conveying the web in a packaging direction and a feeder mechanism configured to deposit pills into the receptacles. A packaging device is disposed downstream of the feeder mechanism with respect to the conveyor and further includes a first wiper device extending across the web and non-perpendicularly to the packaging direction, wherein the first wiper device is configured to engage pills protruding from the receptacles. A second wiper device is disposed downstream of the first wiper device and extends across the web substantially perpendicularly to the packaging direction. The second wiper device is configured to engage any pills still protruding from the receptacles following engagement with the first wiper device. The first and second wiper devices are further configured to oscillate substantially transversely to the packaging direction so as to vibrate laterally with respect to the web. The lateral vibration of the first and second wiper devices, as the wiper devices engage any protruding pills, thereby causes the protruding pills to be manipulated into the laid-down position in the corresponding receptacles.

Yet another advantageous aspect of the present invention comprises a method for packaging pills in individual receptacles in a web being conveyed in a packaging direction. First, pills are deposited into the receptacles in the web. A first wiper device,

disposed non-perpendicularly with respect to the packaging direction, then engages any pills protruding from the receptacles. A second wiper device, disposed substantially perpendicularly with respect to the packaging direction, is then engaged with any pills still protruding from the receptacles following engagement with the first wiper device.

5 The first and second wiper devices are concurrently oscillated substantially transversely to the packaging direction such that the first and second wiper devices vibrate laterally with respect to the web. The lateral vibration of the first and second wiper devices, as the wiper devices engage any protruding pills, thereby causes the protruding pills to be manipulated into a laid-down position in the corresponding receptacles.

10 Thus, embodiments of the present invention provide significant advantages as disclosed, described, and further detailed herein.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

Having thus described the invention in general terms, reference will now be made  
15 to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

**FIGS. 1 and 2** are schematic perspective views of a pill packaging apparatus including a packaging device according to one embodiment of the present invention;

**FIG. 3** is a schematic plan view of a packaging device according to one  
embodiment of the present invention;

20 **FIG. 4** is a schematic cross-sectional view of a wiper device component of a packaging device according to one embodiment of the present invention;

**FIG. 5** is a schematic bottom view of a packaging device according to one embodiment of the present invention; and

25 **FIG. 6** is a schematic front view of a packaging device according to one embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

The present invention now will be described more fully hereinafter with reference  
30 to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, this invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these

embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

**FIGS. 1 and 2** disclose one embodiment of a pill packaging apparatus, indicated generally by the numeral **100**, for packaging pills in a series of pill receptacles. The pill packaging apparatus **100** generally comprises a conveyor **120**, a feeder mechanism **140** extending over the conveyor **120**, and a packaging device **160** disposed downstream of the feeder mechanism **140** with respect to the conveyor **120**. Typically, the conveyor **120** conveys a series of blister packages **180** generally horizontally along the travel path of the conveyor **120**. The feeder mechanism **140** deposits pills **200** into the blister packages **180** in a predetermined manner as the blister packages **180** are transported by the conveyor **120**. A more detailed description of an apparatus having a feeder mechanism for supplying pills into a series of pill receptacles being transported on a conveyor thereunder may be found, for example, in U.S. Patent No. 5,737,902 to Aylward.

As used herein, the term "pill" is intended to include all types of small discrete products of the type which may be used in the pharmaceutical industry, including pills, tablets, capsules, caplets, and soft gel caplets or the like. Similarly, the packages are illustrated as blister packages having blisters that may be formed by thermoforming if the packages are made from a thermoplastic material. It will be understood, however, that the present invention is not limited to placing pills into blister packages, but indeed may be used for placing pills into a variety of different pill receptacles. In addition, it will be understood that the present invention is not limited to placing pills into disposable pill packages, but may also be used for placing pills into reusable holders so that the pills may then be transferred to other operations, such as a pill placement device for moving the pills from the holder into a disposable package. Thus, the examples disclosed herein with respect to embodiments of the present invention are not intended to be limiting or restricting, and one skilled in the art will appreciate that the apparatuses and methods disclosed herein may also be applicable to many different configurations of pill packaging apparatuses and associated methods.

The blister packages **180** typically comprise, for instance, a generally planar web portion **182** and a plurality of receptacles **184** extending below the web portion **182**. As the blister packages **180** pass underneath the feeder mechanism **140** in a packaging

direction (shown as arrow 110), at least one pill 200 is typically released into each receptacle 184. Once pills 200 have been deposited into each receptacle 184, the receptacles 184 are typically sealed with a foil or other sealing layer (not shown) applied to the planar web portion 182.

5 In some instances, for example, where the receptacles 184 are dimensioned in close tolerance to the pills 200, the pills 200 may not lie flat within the receptacles 184 after being deposited therein by the feeder mechanism 140, as shown in FIGS. 1, 2, and 4. Accordingly, such pills 200 are referred to herein as “protruding” from the receptacles 184. The protruding pills 200 may, for example, lie against the opening of the receptacle 184 at the planar web portion 182 or, where the pills 200 have a flat band 202 extending around the perimeter thereof, the pills 200 may even “stand up” on the band 202 within the receptacle 184. In such instances, the sealing layer may be difficult to apply or not capable of being applied to the planar web portion 182 to seal pills 200 within the receptacles 184. Thus, after each blister package 180 has passed under the feed 10 mechanism 140 and has received the appropriate amount of pills 200 therein, the blister packages 180 are serially conveyed downstream in the packaging direction 110 by the conveyor 120 to pass under the packaging device 160 for manipulating any protruding pills 200 into the desired flat orientation or “laid-down position” within the individual receptacles 184.

20 As shown in FIGS. 2-6, a packaging device 160 according to embodiments of the present invention includes at least one first wiper device 300 configured to be capable of engaging at least some pills 200 protruding from the receptacles 184. Preferably, the first wiper device 300 extends across the blister package 180 and is disposed non-perpendicularly with respect to the packaging direction 110. In one advantageous 25 embodiment, the first wiper device 300 is disposed at an angle of about 45° with respect to the packaging direction 110, though one skilled in the art will appreciate that the angle may vary. Since the embodiment shown in FIGS. 1-6 includes three series of blister packages 180 being conveyed in the packaging direction 110 by the conveyor 120, three such first wiper devices 300 are illustrated, wherein each first wiper device 300 is 30 configured to interact with a respective one of the series of blister packages 180. Each



first wiper device 300 is configured to extend across a series of blister packages 180 so as to be capable of engaging pills 200 protruding from the receptacles 184.

5 The packaging device 160 further includes at least one second wiper device 350 disposed downstream of the first wiper device(s) 300 and substantially perpendicularly with respect to the packaging direction 110. In the embodiment shown in FIGS. 1-6, a single second wiper device 350 extends across the three series of blister packages 180, though one skilled in the art will appreciate that the second wiper device 350 may vary in number if desirable. The second wiper device 350 is thus configured to extend across the series of blister packages 180 engaged by the corresponding first wiper device 300 so as  
10 to be capable of engaging any pills 200 still protruding from the receptacles 184 following engagement with the first wiper device 300.

In one advantageous embodiment of the present invention, the first and second wiper devices 300,350 are further configured to vibrate when engaging protruding pills 200 so as to manipulate the protruding pills 200 into the laid-down position within the  
15 corresponding receptacle 184 in the blister package 180. More particularly, in some embodiments, the first and second wiper devices 300,350 are configured to oscillate transversely with respect to the packaging direction 110 and at a sufficient frequency such that the first and second wiper devices 300,350 essentially laterally vibrate with respect to the series of blister packages 180 being conveyed by the conveyor 120. In this  
20 manner, the laterally vibration of the first and second wiper devices 300,350 and the contact between the first and second wiper devices 300,350 and the pills 200 protruding from the receptacles 184 combine to manipulate the protruding pills 200 into the laid-down position within the corresponding receptacles 184.

As shown, the first and second wiper devices 300,350, in some instances, are  
25 mounted to a plate 400, wherein the plate 400 is configured to support the first and second wiper devices 300,350 above the blister packages 180 being conveyed by the conveyor 120 so as to allow the first and second wiper device 300,350 to engage any pills 200 protruding from the receptacles 184. One skilled in the art will further appreciate that the pill packaging apparatus 100, as described, may be configured as a continuous  
30 motion pill packaging apparatus, wherein the conveyor 120 continuously conveys the blister packages 180, and an indexing pill packaging apparatus, wherein the blister

packages 180 are moved in successive discrete indices such that one blister package 180 at a time is acted upon by the feeder mechanism 140 and packaging device 160. Where the pill packaging apparatus 100 is a continuous motion pill packaging apparatus, the packaging device 160 as described herein may be configured to be stationary with respect to the conveyor 120 so as to act on the protruding pills 200 as the blister packages 180 are continuously conveyed under the plate 400. In instance where the pill packaging apparatus 100 is an indexing pill packaging apparatus, the packaging device 160 may be stationary and configured to act one the protruding pills 200 as the blister packages 180 are moved to the next successive discrete index. In other instances, the packaging device 160 may be configured to move with respect to the blister packages 180 so as to act on the protruding pills 200 as the blister packages 180 are between indices and stationary on the conveyor 120. After acting on the protruding pills 200 in a particular blister package 180, the packaging device 160 is then returned to register to await the next blister package 180 at the next index of the conveyor 120.

Some embodiments of the packaging device 160 may also include a vibration-inducing device 500 engaged with the plate 400 for facilitating the transverse oscillation of the first and second wiper devices 300,350. The vibration-inducing device 500 may particularly comprise, for example, a pneumatic vibrator 525 for producing the necessary vibration, controlled by a frequency controller 550 for controlling the frequency of the vibration, though one skilled in the art will appreciate that the transverse oscillation of the first and second wiper devices 300,350 may be accomplished in many different manners such as, for example, by using a piezoelectric device. The pneumatic vibrator 525, in one instance, is mounted to the plate 400 substantially transversely to the packaging direction 110 such that, upon actuation, the lateral vibration is transmitted to the first and second wiper devices 300,350 via the plate 400. However, one skilled in the art will appreciate that, in some cases, the packaging device 160 may be configured so as to allow the vibration-inducing device 500 to vibrate the first wiper device 300 at a different frequency from the second wiper device 350.

In some cases, it may be advantageous to isolate the vibration produced by the vibration-inducing device 500 from the conveyor 120. For example, such vibration isolation may be advantageous in reducing or eliminating blurred vision data in vision

systems used along the pill packaging apparatus 100. Accordingly, the plate 400 may be mounted to the conveyor 120 via mounting members 600, wherein the mounting members 600 are configured in such case to dampen the vibrations or otherwise substantially isolate the conveyor 120 from the vibrations. For example, the mounting members 600 may comprise a solid resilient member or a hydraulic dampening device, as will be appreciated by one skilled in the art. In the alternative, the plate 400 may be supported by a separate frame (not shown) extending over the conveyor 120, with the frame including vibration-dampening provisions.

As also shown in FIGS. 2-6, the first and second wiper devices 300,350, in some embodiments, are configured to be mounted to an upper surface 410 of the plate 400 and extend through respective slots 650 defined by the plate 400 so as to be capable of engaging the protruding pills 200. One advantage of such a configuration is that the first and second wiper devices 300,350 may be accessed from above the plate 400 without having to remove the plate 400 from the mounting position above the conveyor 120. Further, the first and second wiper devices 300,350 should be mounted with respect to the plate 400 so as to be capable of manipulating the protruding pills 200 into the laid-down position within the receptacles 184, but without dragging the pills 200 out of the receptacles 184 and/or without causing damage to the pills 200 or corresponding receptacles 184 by trapping the protruding pills 200 against the planar web portion 182/receptacle 184 interface. Accordingly, the first and second wiper devices 300,350 are mounted to the plate 400 in spaced apart relation with respect to the planar web portion 182 so as to be capable of engaging the protruding pills 200, but without causing the aforementioned undesirable effects, as will be appreciated by one skilled in the art

In some instances, the receptacles 184 are arranged in columns with respect to the packaging direction 110 in the blister package 180. As such, it would also be undesirable for the lateral vibration of the first and second wiper devices 300,350 to move a protruding pill 200 to a different column in the blister package 180. Accordingly, in such instances, the lower surface 420 of the plate 400 defines a plurality of channels 430 extending in the packaging direction 110 and corresponding to the columns of receptacles 184 in the blister package 180. Adjacent channels 430 are separated by a tine 440 having a width roughly corresponding to the separation distance between adjacent columns in the

blister package 180, wherein each tine 440 is configured to extend into proximity with the planar web portion 182 of the blister package 180 so as to prevent movement of pills 200 between columns. Each channel 430 extends toward the upper surface 410 of the plate 400 and ends in an upper bound 435. As such, in order for the first and second wiper devices 300,350 to engage the protruding pills, each slot 650 extends through the upper bounds 435 of the channels 430 and partially through the tines 440 separating the channels 430, as shown in FIG. 4. One skilled in art will also appreciate that the separate channels 430 and the limited transverse translation of the first and second wiper devices 300,350, while the first and second wiper devices 300,350 are laterally vibrated, may also reduce or eliminate cross-contamination in instances where the pills 200 loaded into one column of the blister package 180 are different from the pills 200 loaded into an adjacent column.

One skilled in art will also appreciate that there may be instances in which the pills 200 loaded into one row of the blister package 180, transverse to the packaging direction 110, are different from the pills 200 loaded into the next adjacent row. For example, two different types of pills 200 may be loaded in alternating rows in the blister package 180. In such instances, two packaging devices 160 as described herein may be provided, or a single packaging device 160 with two sets of first and second wiper devices 300,350, whereby each packaging device 160 or each set of first and second wiper devices 300,350 is configured to act upon every other row of the blister package 180 and thus interact with only one type of pill 200 during the packaging process. Accordingly, a pill packaging apparatus 100 configured in such a manner may also reduce or eliminate cross-contamination between the adjacent rows of the blister package 180.

In some embodiments of the present invention, the first and second wiper devices 300,350 may comprise, for example, a cloth material or other material approved by the appropriate regulatory agency as being suitable for use in pharmaceutical packaging operations. In the alternative, for example, the first and second wiper devices 300,350 may comprise an appropriately configured rubber or polymer material. The material comprising the first and second wiper devices 300,350 thus functions as a wiper and

should be capable of manipulating the protruding pills **200** into the receptacles **184** without causing abrasion of or otherwise damaging the pills **200**.

In cases where the first and second wiper devices **300,350** are comprised of a cloth material, the packaging device **160** may include one or more support members **700** disposed adjacent to and extending along the length of each slot **650**. The support members **700** are configured such that, when a straight edge **725** of a strip **750** of the cloth material is inserted into a slot **650**, the remainder of the strip **750** may be folded over the support member(s) **700** and secured thereto by one or more clip members **800**.

Preferably, the strip **750** extends substantially along the length of the corresponding slot **650**, with the support member(s) **700** and corresponding clip member(s) **800** cooperating to secure the strip **750** to the plate **400** and contiguously support the strip **750** along the length of the respective slot **650** so as to facilitate the lateral vibration of the strip **750**. In this manner, the strip **750** is also readily removable through removal of the clip member(s) **800** securing the strip **750** to the support member(s) **700**. As such, the strip

**750** may be easily replaced when worn out or to prevent cross-contamination in a subsequent pill packaging process. One skilled in the art will appreciate, however, that the first and second wiper devices **300,350** may be configured in other manners. For example, the strip **750** may be permanently attached to the support member(s) **700** to form a wiper assembly, wherein the support member(s) **700** may be configured to be capable of removably engaging the plate **400** such that the entire wiper assembly is replaced when necessary.

Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. For example, the procedure described herein supports a method of packaging pills **200** in receptacles **184** in a blister package **180**. More particularly, after depositing the pills **200** into the receptacles **184**, the first wiper device **300** disposed non-perpendicularly with respect to the packaging direction **110** is brought into engagement with any pills **200** protruding from the receptacles **184**, whereafter the second wiper device **350**, disposed substantially perpendicularly with respect to the packaging direction **110**, is then brought into engagement with any pills **200** still protruding from the receptacles **184** following

engagement with the first wiper device 300. The first and second wiper devices 300,350 are oscillated substantially transversely to the packaging direction 110 so as to vibrate laterally with respect to the blister package 180, concurrently with the respective engagements of the first and second wiper devices 300,350 with the protruding pills 200, and thus cause any protruding pills 200 to be manipulated into a laid-down position in the corresponding receptacles 184. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.